

# Mitigation of Shallow Mining Risks

## What is the situation?

The UK has a wide range of mineral deposits which have been, and in some cases continue to be, exploited by a variety of mining methods determined either by the type and configuration of the mineral deposit or the technology available at the time of mining. The legacy of this mining activity is that there are numerous caverns, voids, broken ground, tunnels, shafts and adits in the vicinity of the railway. Underground workings, particularly where shallow, may collapse and cause surface settlement, and if this occurs within close proximity to the railway corridor it can have a significant impact on both the safety and performance of the railway.

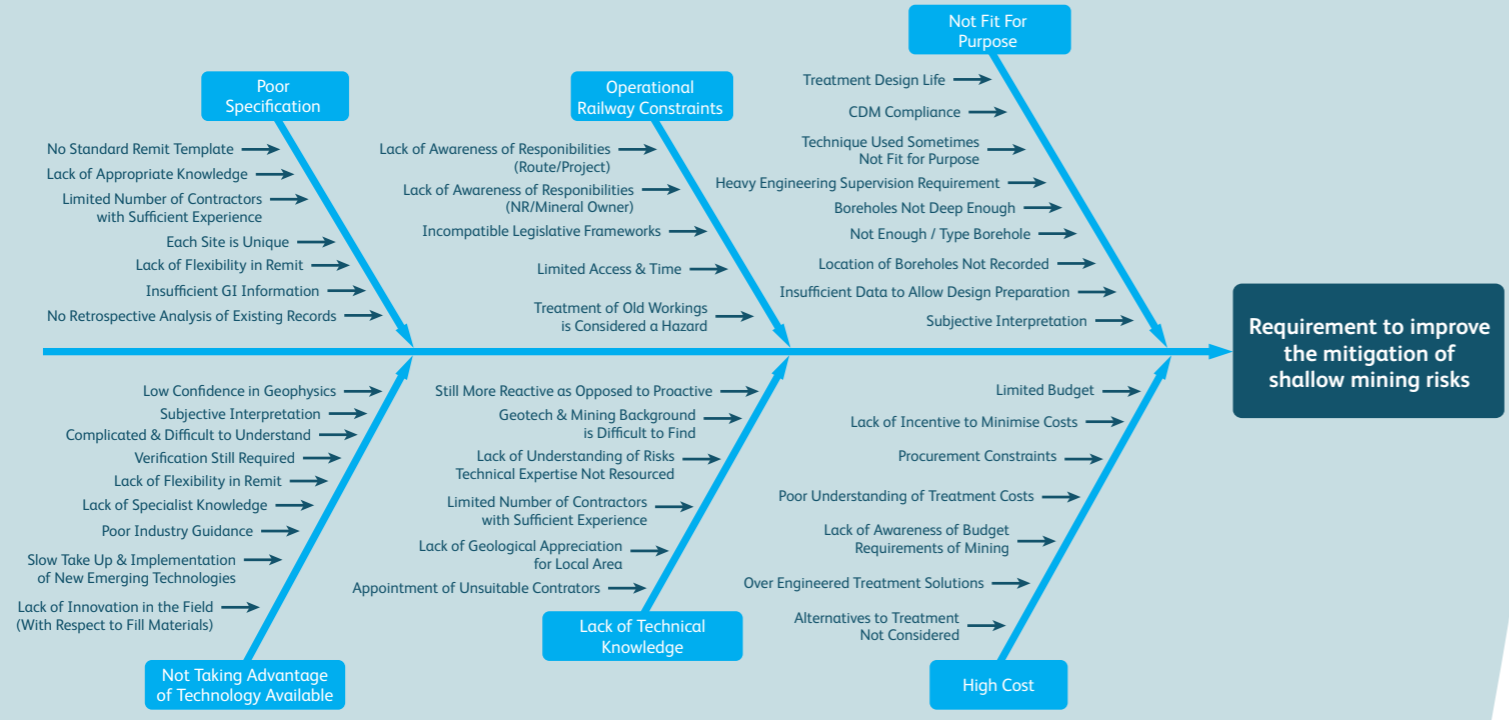
Existing Network Rail records indicate that there are in excess of 5000 known shallow mining hazards near the railway, which includes both mine workings and mine entries. Network Rail are in the process of risk ranking all of the known shallow mining hazards in order to prioritise pro-active investigation and treatment.

Each of the high risk sites will require a desk study, which in many cases will recommend that site investigation be carried out. Following site investigation it is expected that mitigation measures will need to be designed and implemented for a significant number of the high risk mining hazards.

Historically the mitigation of shallow mine working hazards beneath the railway has involved ground consolidation, whereby grout is injected under gravity pressure through boreholes to fill any sub-surface voids so that sub-surface support lost by excavation can be replaced or maintained. This type of mitigation has proven to be very expensive in a railway environment.

In order to meet our obligations within the available budget and timescale, significant improvements need to be made to our mitigation practices. To meet this challenge we must develop a new mitigation strategy, that utilises innovative solutions drawn from both new and existing technologies.

## Analysis of causes



## Priority problems

### Specific priority problems

- Treatment of shallow mine workings and mine entries on the railway is expensive.
- Sometimes not fit for purpose, inappropriate techniques used.
- Failure to embrace new technologies and lack of innovation in the field.

### Related goal

- There is an obligation for all routes to provide adequate permanent and sustainable mitigation for at least the 20% of the High Risk sites in their route area by the end of CP6.

### Benefit

- Routes will be able to meet their obligations and the risks posed by shallow mine workings to the railway will be significantly reduced.

## Specific research needs

In order to address this challenge, we are looking for expressions of interest relating to the research and development of:

1. Ground consolidation (Examples of research areas include: drilling and grouting techniques and materials, potential use of secondary aggregates, foam injection etc).
2. Bulk filling (Examples of research areas include: the potential application of 'paste' technology).
3. Bridging techniques (Example research areas include: installation of concrete slabs beneath the track, the use of geogrid).
4. Sub-surface ground control measures (Example research areas include: stowing of old workings, installation of support in old workings e.g. roof bolts, pillar reinforcement).
5. Non-physical mitigation measures (Example research areas might include: monitoring for precursory movement, the potential use of other monitoring technologies such as satellite data).

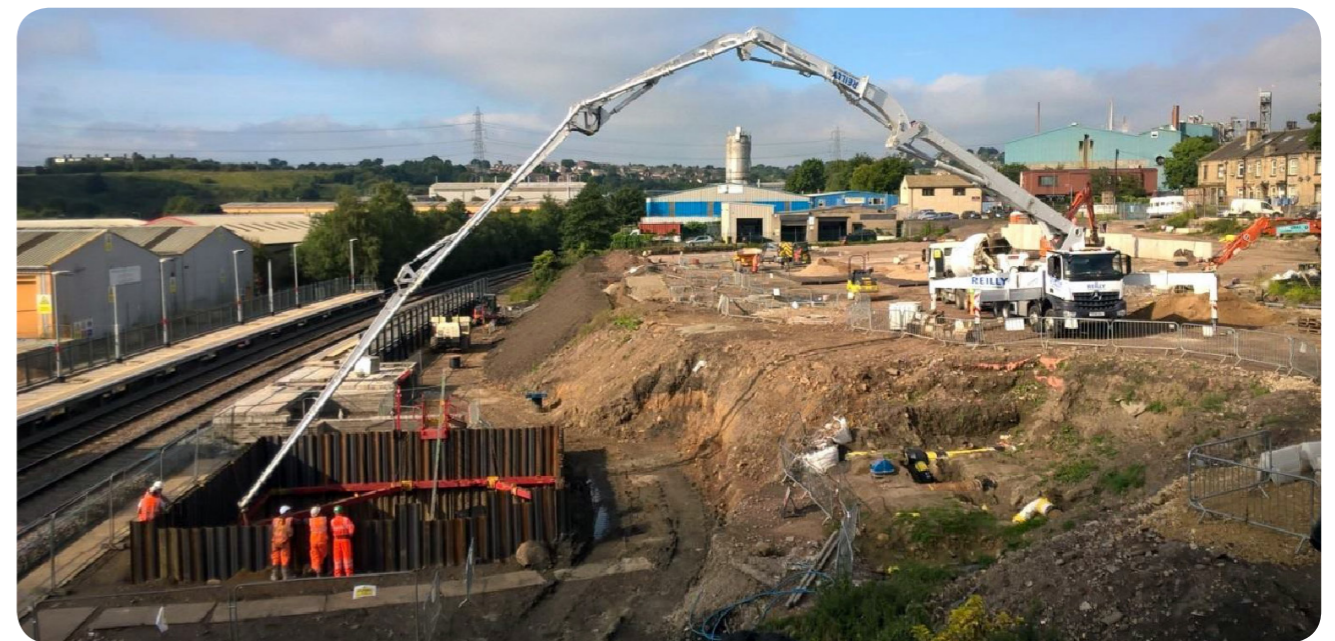


Fig. 1 - Construction of the shaft cap at Low Moor Station near Bradford